

Page 86, first full paragraph

A2 In this embodiment UNDX (Ono, I. And Kobayashi, S: A Real-coded Genetic Algorithm for Function Optimization Using Unimodal Normal Distribution Crossover, Proceeding of 7<sup>th</sup> International Conference on Genetic Algorithms, pp. 246-253 (1997)) is adopted as a crossover operator. The UNDX generates, from two parents of parent 1 and Parent 2 out of selected parents, two children according to a normal distribution set around them, as shown in Fig. 27. The standard deviation of the normal distribution is set so that a component  $\sigma_1$  along the major-axis direction connecting the both parents is proportional to a distance between the parents ( $\sigma_1 = \alpha d_1$  where  $d_1$ : the distance between Parent 1 and parent 2) and so that a component  $\sigma_2$  along the other axis is proportional to a distance between the major axis and Parent 2 ( $\sigma_2 = \beta d_2$ , where  $d_2$ : the distance between parent 3 and the axis connecting parent 1 with Parent 2). Fig. 27 illustrates an example of two variables.

Page 92, second full paragraph

Fig. 38 shows a state in which the best solution P (the lens system shown in Fig. 31) obtained in Experiment 1 of the first embodiment described above is plotted on the enlarged view of Fig 37. In the drawing letter Q indicates lens systems dominating the solution found by the single-objective optimization of the evaluation criteria. As also apparent from this Fig. 38, it is clearly seen that the second embodiment (multi-objective optimization) obtains many more excellent solutions that that obtained by the single-objective GA. This conceivably suggests that there is a possibility of making the problem harder if the multi-objective problem is forced to the single-objective problem.

Page 96, first full paragraph

A4 Fig. 39 is a schematic diagram of the structure of the photographic lens system. In this figure g designates the image plane. The photographic lens system of this figure is an example of the three-lens configuration, in which there are six boundary surfaces of a to f having their respective curvatures, and six distances of  $d_1$  to  $d_6$  between the boundary surfaces ( $d_1$  between A and B,  $d_2$  between B and C,  $d_3$

between C and D, d4 between D and E, d5 between E and F, and d6 between F and G).

Page 100, second full paragraph

Fig. 41 illustrates a gene representation of ten parameters of continuous values featuring the lens system in the three-lens configuration shown in Fig. 39. In each of a-e and d1-d5 in the same drawing a parameter of the corresponding lens system is stored in the form of continuous value. Among such genes,  $n$  ( $n > 1$ ) genes satisfying the minimum constraints are reproduced arbitrarily.

Page 112, first full paragraph

The  $n$ -dimensional coordinates of the point P4 reproduced by above steps ST4-1 to ST4-6 correspond to the  $n$  parameters  $a, b, c, d, e, d1, d2, d3, d4, d5$  of a chromosome of a new-born gene or a child. In this step ST4 of the fourth embodiment the substeps ST4-1 to ST4-6 described above are repeated  $m$  times, whereby  $m$  new genes are reproduced from the three parents Pa1, Pa2, Pa3.

Page 116, second full paragraph

In the case of the multi-objective optimization, steps ST110 and ST150-ST170 below are executed in place of above steps ST1 and ST5-ST7.

Page 122, second full paragraph, lines 7-13

Size of initial population: 50

Number of Crossovers: 300,000

Number of children generated by crossover operator: 20

$\sigma_a$  of UNDX:  $0.5 \times VC1VC2$

$\sigma_b$  of UNDX: 1

$\sigma_c$  of UNDX:  $0.35 \times (VC1VC2)^{1/n}$